WELDING/METAL FABRICATION
(CIP: 48.0508)

Occupational Skills

The Student demonstrates the specified level of competency in occupational skills:

0	1	2	3	4
No Exposure	Introduced	Practiced	Entry-level	Competency

0 1 2 3 4

0 0 0 0 0 **A. Practice Work Place Safety**
(Vermont Standards: 3.3, 3.5, 7.18)

0 0 0 0 0 **B. Use Reference Materials**
(Vermont Standards: 1.2, 1.2, 1.4)

0 0 0 0 0 **C. Identify and Maintain Welding Tools and Consumables**
(Vermont Standards: 1.1, 3.3, 3.14, 7.18)

0 0 0 0 0 **D. Understand Principles of Metallurgy**
(Vermont Standards: 7.11, 7.12)

0 0 0 0 0 **E. Read Welding Blueprints**
(Vermont Standards: 1.1, 1.2, 1.4, 5.29, 7.11)

0 0 0 0 0 **F. Layout and Measure Projects**
(Vermont Standards: 5.29, 7.6a, 7.6b, 7.6gg)

0 0 0 0 0 **G. Apply Materials Preparation Skills**
(Vermont Standards: 1.13, 1.15, 7.18)

0 0 0 0 0 **H. Operate Shearing, Punching, and Forming Equipment**
(Vermont Standards: 1.15, 7.8)

0 0 0 0 0 **I. Perform Oxy-fuel Welding Tasks**
(Vermont Standards: 1.15, 1.22, 3.5, 3.10)

0 0 0 0 0 **J. Perform Oxy-fuel Cutting Tasks**
(Vermont Standards: 1.5, 1.22, 3.5, 3.10)

0 0 0 0 0 **K. Perform Shielded Metal Arc Welding Tasks (SMAW)**
(Vermont Standards: 1.15, 1.22, 3.5, 3.10, 7.18)

0 0 0 0 0 **L. Perform Gas Tungsten Arc Welding Tasks (GTAW)**
(Vermont Standards: 1.15, 1.22, 3.5, 3.10, 7.18)

0 0 0 0 0 **M. Perform Gas Metal Arc Welding Tasks (GMAW)**
(Vermont Standards: 1.15, 1.22, 3.5, 3.10, 7.18)

θθθθθ **N. Perform Air Carbon Arc Gouging Operations**
(Vermont Standards: 1.15, 1.22, 3.5, 3.10, 7.18)

θθθθθ **O. Perform Welding Inspection Tasks (to be used with all welding processes)**
(Vermont Standards: 1.15, 1.22, 3.5, 3.10, 7.18)

θθθθθ **P. Apply Other Welding Processes**
(Vermont Standards: 1.15, 1.22, 3.5, 3.10, 7.18)

θθθθθ **R. Perform Soldering Tasks**
(Vermont Standards: 1.15, 1.22, 3.5, 3.10, 7.18)

DIRECTIONS

Evaluate the student by checking the appropriate box to indicate the degree of competency. The rating for each competency should reflect **employability readiness** rather than the grades given in class.

Rating Scale:
0 No Exposure
1 Introduced – The student has been exposed through non-participation instruction (e. g., lecture, demonstration, field trip, video).
2 Practiced – The student can perform the task with direct supervision.
3 Entry-level Competency – The student can perform the task with limited supervision and/or does not perform the task to standard (a typical entry-level performance expectation)
4 Competency – The student consistently performs task to standard with no supervision (on at least two occasions or at instructor's option)

WELDING/METAL FABRICATION

0 1 2 3 4

θθθθθ **A. PRACTICE WORK PLACE SAFETY**

*A.001 Define specific safety terms.
*A.002 Demonstrate the use of proper clothing, safety glasses, aprons, shields, breathing apparatus, and other safety equipment.
*A.003 Demonstrate knowledge of appropriate fire safety practices.
*A.004 Demonstrate knowledge of appropriate first aid procedures.
*A.005 Follow proper hazardous material handling procedures in accordance with federal and state regulations, being aware of "Right to Know" regulations.
*A.006 Use tools and equipment listed in the appendix safely (list to be developed by each area vocational center).
*A.007 Identify unsafe conditions and report them to the supervisor.

θθθθθ **B. USE REFERENCE MATERIALS**

*B.001 Be able to use welding techniques and workmanship sections of the AWS D1.1 structural codebook.
*B.002 Be able to use welder qualification section of AWS D1.1 structural codebook.
*B.003 Be able to use the sheet steel codebook (AWS D1.3).
*B.004 Read and interpret AWS welding symbols chart.
*B.005 Prepare a bibliography of welding industry reference materials to the supervisor's satisfaction.

θθθθθ **C. IDENTIFY AND MAINTAIN WELDING TOOLS AND CONSUMABLES**

*C.001 Identify welding tools, equipment, and supplies listed in the appendix (Oxy-fuel, electric arc welding, GTAW, GMAW, and FCAW processes).
*C.002 Correctly identify, store, maintain, handle, and use consumables for welding (consumables list developed by each area vocational center).

θθθθθ **D. UNDERSTAND PRNCIPLES OF METALLURGY**

*D.001 Identify the characteristics of ferrous metals to supervisor's satisfaction.
*D.002 Identify the characteristics of non-ferrous metals to supervisor's satisfaction.
*D.003 Identify metals using: spark test, oxy-fuel torch test, fracture test, color test, magnetic test, and chip test.
*D.004 Describe the effects of temperature change on metals to the supervisor's satisfaction.

θθθθθ **E. READ WELDING BLUEPRINTS**

*E.001 Correctly read the alphabet of lines.
*E.002 Read size and location dimensioning.
*E.003 Communicate with supervisors and co-workers, using proper welding symbols and terminology.
*E.004 Understand and use multiview (orthographic) method in order to illustrate an object correctly.
*E.005 Interpret and use fabrication prints to ensure that the finished product will meet specifications and tolerances.
*E.006 Visualize and sketch objects in proportion.
*E.007 Understand the following techniques to assist in visualizing objects: isometric drawings, auxiliary views, and sectional views.

θθθθθ **F. LAYOUT AND MEASURE PROJECTS**

*F.001 Use appropriate measuring tools, marking tools, layout tools properly in layout work.
*F.002 Layout material so that it may be formed and/or welded to the specifications of the blueprint.
*F.003 Layout materials (+ or -) to the tolerances specified on the blueprint.

θθθθθ **G. APPLY MATERIALS PREPARATION SKILLS**

*G.001 Explain and demonstrate safe practices in materials preparation to the supervisor's satisfaction.
*G.002 Prepare a weldment by grinding, cutting, or cleaning materials to the specifications on the blueprint.
*G.003 Control distortion (+ or -) to the tolerances specified on the blueprint.

θθθθθ **H. OPERATE SHEARING, PUNCHING, AND FORMING EQUIPMENT**

*H.001 Explain and demonstrate safe practices to operate shearing, punching, and forming equipment to the satisfaction of the supervisor.
*H.002 Set up and operate shearing, punching, and forming equipment for the type, thickness, and shape of metal to tolerances.

θθθθθ **I. PERFORM OXY-FUEL WELDING TASKS**

*I.001 Identify and describe the oxy-fuel welding equipment.
*I.002 Describe the oxy-fuel welding process, using the proper terminology.
*I.003 Demonstrate safe use of the oxy-fuel welding equipment.
*I.004 Identify the four flames: fuel-gas in air flame (mapp and acetylene); carburizing flame; neutral flame; and oxidizing flame.
*I.005 Identify the parts of flames: outer cone or envelope; feather; and inner core.
*I.006 Light and adjust the torch to acquire the four different types of flames.
*I.007 Describe and perform essential torch manipulation: showing correct flame adjustment; torch angle; work distance; and travel speed.
*I.008 Carry a puddle.
*I.009 Add metal to a puddle using a filler rod.
*I.010 Weld different joint designs: butt, lap, tee, and outside corner.
*I.011 Braze weld cast iron.
*I.012 Heat metal using the proper equipment and procedures for the purpose of performing the following tasks: bending, heat treating, hardening, etc. (manifolding of heating of equipment).
*I.013 Perform "forehand" and "backhand" welding.
*I.014 Bond metals using the following non-fusion welding techniques: brazing, bronze welding, and silver soldering.

θθθθθ **J. PERFORM OXY-FUEL CUTTING TASKS**

*J.001 Demonstrate safety procedures to protect self and co-workers from hot materials and harmful light rays.
*J.002 Demonstrate proper cylinder set-up procedures.
*J.003 Demonstrate fuel cylinder shutdown, including emergency shutdown.
*J.004 Describe the pre-heating process.
*J.005 Describe the purpose of high-pressure oxygen in the cutting process.
*J.006 Set up and test the oxy-fuels (acetylene and mapp) cutting equipment.

*J.007 Select the proper cutting torch body and attach it to the equipment.
*J.008 Identify, select and attach the correct cutting tip, according to manufacturers' specifications.
*J.009 Test for leaks using leak testing solution (non-hydrocarbon base).
*J.010 Clean cutting tip, using proper equipment.
*J.011 Set oxygen and fuel gas pressure (acetylene not to exceed 15 psi).
*J.012 Adjust the pre-heat flames to acquire a neutral flame.
*J.013 Demonstrate the following oxy-fuel cutting processes: straight line cut; beveling; piercing and hole cutting; shape cutting; and gouging (using the proper tip for each function).
*J.014 Observe automatic cutting machine operation: tracer; magnetic tracer; numeric control shape cutter; and electronic control shape cutter (field trip).

θθθθθ **K. PERFORM SHIELDED METAL ARC WELDING TASKS (SMAW)**

*K.001 Demonstrate safe shielded metal arc welding practices: arc rays protection; burn prevention; protective equipment; electrical shock prevention; and general shop care.
*K.002 Describe the principles of the shielded metal arc welding process: purpose of power sources; action of arc from electrode to solidification; parts of the welding circuit; variables of SMAW (amperage, arc length, electrode angle, rate of travel); advantages/disadvantages of SMAW.
*K.003 Identify and distinguish between SMAW power sources (cc, cv, vv, cp).
*K.004 Identify and describe SMAW equipment: connectors (lugs, splicers, quick connectors); cables (sizes); ground connectors; electrode holder; remote controls; chipping hammer; wire brush; and electrodes.
*K.005 Perform set up of equipment, adjusting for proper polarity for each power source and electrode used.
*K.006 Disassemble and reassemble internal/external SMAW accessory connections and leads.
*K.007 Start an arc and run a bead, demonstrating proper arc length.
*K.008 Perform padding using stringer beads and/or weave beads.
*K.009 Perform flat fillet welds, using stringer and weave beads.
*K.010 Perform Flat V groove welds, using stringer and weave beads.
*K.011 Perform horizontal fillet weld.
*K.012 Perform horizontal groove weld.
*K.013 Perform vertical fillet weld (up and down hand).
*K.014 Perform vertical groove weld (up and down hand).
*K.015 Perform overhead fillet weld.
*K.016 Perform overhead groove weld.
*K.017 Perform welds, using 6011, 7018, 7024 (AWS) electrodes.

θθθθθ **L. PERFORM GAS TUNGSTEN ARC WELDING TASKS (GTAW)**

*L.001 Demonstrate safe gas tungsten arc welding practices; arc rays radiation; burn prevention; protective equipment; electrical shock prevention; and general shop care.
*L.002 Explain the principles and fundamentals of GTAW: advantages/disadvantages of process; why high frequency is used; use of shielding gases; relationship of GTAW to a puddling process.
*L.003 Identify GTAW power supplies, explaining their differences.
*L.004 Identify various tungsten electrodes and determine if they are ground finish, chemical finish, thoriated, zirconium, or pure tungsten.
*L.005 Identify remote control leads and rheostat.
*L.006 Identify GTAW shielding gases equipment: cylinders, regulators, flow meters, and hoses.
*L.007 Identify GTAW torches and their parts.
*L.008 Disassemble and reassemble torches, identifying internal/external parts.
*L.009 Set up and operate GTAW equipment, having prepared the proper tungsten (ground finish or balling).
*L.010 Start an arc and run a bead on ferrous and non-ferrous materials.
*L.011 Weld in flat position, passing inspection of work by supervisor.
*L.012 Demonstrate proper tungsten preparation and selection, being aware of contamination.
*L.013 Weld out of position, passing inspection of work by supervisor.

θθθθθ **M. PERFORM GAS METAL ARC WELDING TASKS (GMAW)**

*M.001 Describe safe GMAW welding practices.

*M.002 Explain the principles of the GMAW process: power source; shielding gases; parts of welding circuit; action of arc from contact tip to weld solidification; types of transfer (spray arc and short arc); advantages of process; disadvantages of process; and variables of GMAW (amperage, voltage, wire feed speed, shielding gases, shielding gases flow rate, rate of travel, angle of torch, electrode stick out).
*M.003 Disassemble and reassemble guns and wire feeders, identifying internal/external parts (making sure all parts are consistent with wire size being used).
*M.004 Perform proper maintenance of tips and shielding nozzles.
*M.005 Set up and operate GMAW power source and equipment.
*M.006 Set an arc and run a bead.
*M.007 Flat position GMAW: short-circuiting method (dip-transfer) and/or spray arc method.
*M.008 Weld out of position: short-circuiting method (dip transfer) and/or spray arc method.

θθθθθ **N. PERFORM AIR CARBON ARC GOUGING OPERATIONS**

*N.001 Describe safe practices when using air carbon arc gouging operations: ultra-violet rays; infrared rays; burns; electrical shock; metal particles; and high-pressure air.
*N.002 Identify principles and variables of air carbon arc gouging to supervisor's satisfaction.
*N.003 Describe and identify air carbon arc gouging power source and equipment to supervisor's satisfaction.
*N.004 Set up air carbon arc gouging power sources and equipment.
*N.005 Safely operate the air carbon arc gouging torch.

θθθθθ **O. PERFORM WELDING INSPECTION TASKS (TO BE USED WITH ALL WELDING PROCESSES)**

*O.001 Describe procedures for weld testing: magnetic particle, ultrasonic, hydraulic benders, impact machines, penetrants, black light X-ray (Go/No Go), and visual (field trips).

θθθθθ **P. APPLY OTHER WELDING PROCESSES**

*P.001 Describe the principles of plasma arc welding and cutting processes to the supervisor's satisfaction.
*P.002 Safely perform maintenance welding (part repair, build up, and surface).

θθθθθ **Q. PERFORM SOLDERING TASKS**

*Q.001 Describe and demonstrate safe handling of the heating devices used for soldering: oxy-fuel welding equipment; soldering coppers; air-fuel soldering equipment; and soldering guns.
*Q.002 Explain and demonstrate the use of fluxes: paste, liquid, and core.
*Q.003 Describe and demonstrate the use of the preparation materials.
*Q.004 Identify and describe solder.
*Q.005 Identify and describe clamping devices and methods.
*Q.006 Perform tinning of the soldering copper and metal.
*Q.007 Perform soldering operation using different alloys of solder.